L. II-27—100,000—21-5-52.

Agriculture (1953) Department.

SERIES.

G.O. No. 158

Dated

[Despatch Abstract.]

Agriculture - I.C.A.R. - Scheme for the cytogenetical studies on Mangoes - Forwarded.

DEVELOPMENT DEPARTMENT.

Letter Ms.No. 1081, dated 4-3-48.

To

The Secretary to the Indian Council of
Agricultural Research,
New Delhi (with enclosures).

Sir,

Sub: Agriculture - Indian Council of Agricultural Research - Scheme for the Cytogenetic studies on Mangoes - Forwarded.

Ref: Your letter No. F.122(2)/47-H,dated 20-9-47.

I am directed to invite a reference to the Council's letter cited, and to forward herewith a scheme for the Cytogenetic Studies on Mangoes.

The scheme is proposed for a period of ten years and is estimated to cost Rs.56,076 recurring for the entire period. Non-non-recurring expenditure is involved in the scheme. It is ppoposed to share the recurring expenditure between the Indian Council of Agricultural Research and the Provincial Government on a 50:50 basis.

I am to request that the sanction of the Indian Council of Agricultural Research may be obtained and communicated to this Government at an early date.

Yours faithfully,

Sd. x x
Secy. to Government.

Copy to the Director of Agriculture,
He is requested to submit the printed copies of the scheme for thansmission to the Indian Council of Agricultural Research.

# A SCHEME OF CYTOGENETIC STUDIES ON MANGOES IN MADRAS.

## INTRODUCTION.

Mango is the fruit par excellence of India. It is believed that Madras is among the leading mango-producing regions of the country. For exquisite quality of fruits, economic production cost, the longest bearing seasons, off-season fruit production by far the most reputed. With nearly 300 varieties under common cultivation and with a monopoly for the production of the polyembryonic mango races and off-season bearing strains it can truly be said that the province offers unrivalled opportunities for the conduct of investigations such as would produce seedless mangoes of diverse characters and quality. It is fortunate that there are at the Fruit Research Station, Kodur, a collection representing nearly 100 varieties of the choicest mangoes, about ten polyembryonic varieties, three species of MANGIFERA and some clonal off-season bearing strains. Besides, the province is believed to have numberous types of wild mangoes in the forest areas, good many of which may constitute valuable germplasm for hybridisation. Thus this province offers a very good field for the Cytogenetic investigation on mango. These very reasons constitute an important argument for effecting such economic improvements as would further and maintain the superiority of the province in the field of mango production and if possible to strengthen its monopoly for production of fruits of distinct quality or character. The production of a seedless mango is one amongst such improvements that will be an asset not merely because of its being a novelty but also because of its repercussions on the province's mango production and wealth.

As against the aforesaid unique advantages it is necessary to set forth some obvious limitations inherent in any of the research schemes under notice. It has to be remembered that not much Cytogenetical work on Indian fruit crops have been done. The production of seedlessness in mangoes will therefore constitute the breaking of new ground and consequently the adoption of procedure based mostly on hypotheses. Work in other countries has established from the days of Luther Burbank that production of seddless fruits is within the realm of possibility. Further all work on fruit crops is essentially of a long range character. Based on a Cytogenetical investigation it is bound to be even more so considering the fact that one has to proceed largely with a material that is only inadequately known. Excepting for a few sketchy investigations designed merely to determine the chromosome numbers of a few provincial varieties, systematic descriptions, the small scale hybridisation work at Kodur and Sabur, and other investigations on cultural practices there is praetically nothing known about the chromosomes or genetic constitution of the mango. It seems certain that if an optimistic forecast has to be made of the results of the proposed work, it will not be less than ten years after the scheme is initiated and put into effect.

## REVIOUS WORK.

There is practically little to record or review by way of past investigations in the field of

cytogenetics...

cytogenetics of the mango. Maheswari (1) is perhaps the first to have ventured in the field. He contented himself by merely recording the 2n 52 as the chromosomal number of one variety of mango. Later E.K.Janaki Ammal (2) (unpub) reported 40 as the 2n number. An Indian Council of Agriculture Research scheme on the cytogentics of mango and banana has been in progress in the Calcutta University for some time but this work toom has hot progressed much beyond that of recording the chromosome numbers of a few varieties. It is hhus clear that past work in the field has been largely of a very elementary character which though of some value is nevertheless circumscribed by the lack of facilities which prevented the follow up to th any tangible stage of economic application. The planning out of the Indian mango, therefore, is yet to be done and is obviously long overdue considering the unique importance that the fruit occupies in the Indian estimation and economy.

## WORK ON OTHER FRUIT CROPS.

Cytogenetical investigations on fruit crops have been done extensively in Europe and America. In apples and pears it is found that the best economic varieties include a number of triploids (Nebel 3-4), Crane and Lawrence (5); Darlington and Moffett (6); Moffett (7); and Miedzyrzecki (8). These triploids are all parthenocarpic. In Cherries, prunes, plums, peaches, and almonds on the other hand the triploids are only useful as ornamental plants since in these fruits fertility is absolutely necessary (Darlington (8--1); Mather (19); Okable (13); Rybin (17)/. The pentaploids are also found to be highly sterile (Crane and Lawrence 14). In the Strawberries, Dewberries and Loganberries the cultivated forms include a number of polyploids (Ichijima 15, Crane and Darlington 16, Custaffson 18, etc.). In grapes the Muscat and Sultanina are found to be tetraploids. The VINIFERA group shows polyploidy (Nebel 19, Cristoff 22). The Sultania and Muscat groups are seedless forms. In the Citrus some of the commercial varieties are polyploids and also triploids (Krug and Bacchi 20-21, Bacchi 23). The pomegranate shows a certain amount of irregularity (Yasui 24; Kostoff 25). The cultivated bananas show high polyploidy with triploids, pentaploids, octoploids and also aneuploid series (Cheesman and Larter 26; Dodds 28; Chesseman and Dodds 27). The cultivated tomatoes contain triploids and tertraploids also (Vilmorin 29; Jorgenson 30; Upcott 31). Sansome and Zilva (32) found that the tetraploid tomatoes had a higher vitamin C potency and the juice of the 4n plant had more dry matter than in diploids. The fertility of the 4n plant further is lower than the diploids, thus having more flesh. It is thus seen that in the fruit crops polypoloidy, is general and some of the economic varieties are polyploids. Apart from this hybridisation work has been extensively done in the generae PRUNUS, PYRUS, VITIS, FRAGARIA, etc. From these trials the detailed compatibility and sterility in each genus has been studied.

The vinifera group shows polopploidy Nebel 19, Chhistoff 22).

PARTHENOCARPY.

- Parthenocarphy or seedlessness may arise due to several causes. It is said to be natural when the seedless fruit develops without fertilization. This is also termed vegetative, or autonomic (Wong 33); if the formation of a fruit depends upon or is influenced by the stimulus of pollen on the stigmas or by the growth of pollen tubes in the style or ovary of by hormones and other physical-chemical stimuli on or in the style or ovary the condition is called 'stimulative 'aitinomic' or 'artificial' parthenocarpy (Wong). Natural parthenocarpy occurs in bananas, citrus fruits, vinifera grapes, chinese persimone, tomatoes, and in certain cucumbers. In the apples, pears and tomatoes seedless fruits occur in plants which are either triploids or aneuploids. In these fruits out of a number of ovaries present often only one need be fertilized to stimulate the development of the thalamus or the ovary. Often the embryo breaks down after some growth as in the case of the sultanina grapes. In the figs various degrees of parthenocarpy are noted. In the edible fig it is complete whereas the capri fig shows parthenocarpic development in only certain types. In all these types fertilization and stimulation of pollination are necessary for the further development of the fruits. In the case of cherries, plums, prunes and peaches the development of the seed is absolutely necessary for the development of the fruit. In straw berries and other berries the size of the fruit is directly dependent on the number of drupels set. In citrus again a fruit can develop with only a few seeds setting or even the formation of abortive seeds. Thus it may be summaried that chromosomal aberrations induce the formation of seedless fruits.

A number of workers, cheif amongst them Gustaffson (34-38) Swarbrick (41) have attempted at inducing parthenocarpy with various degrees of success. Gustaffson has been successful to certain extent in inducing parthenocarphy in tomatoes, peppers, squash and egg plants by treating ovaries with known hormones in lanolin paste. Of these the much used chemical is Naphthalene-acetic-acid. The hormones could be used as an aqueous solution or in lanolin. It has been sprayed on apple trees with indifferent success (Varrelman 39). Wong repeated the experiements of Gustaffson and found that in watermelon the fruit setting was good with no adverse effects as to flavour or taste. These experiments have as yet remained as small scale laboratory trials. Still they show a possible way to induce seedlessness in fruits.

Crane and Lawrence (14) in tracing the origin and Improvement of the Cultivated plants come to the following conclusions, after considering the available genetical, cytological and taxonomical data. Selection operates in all the following cases:-

"(1) Gene mutation, (2) interspecific hybridisation between diploid species, not accompanied by chromosome duplication or other cytological aberration, (3) simple autopolyploidy, such as the functioning of unreduced germ cells or chromosomal duplication, without hybridisation, (4) interspecific hybridisation accompanied by chromosome doubling and other aberrations, and (5) interspecific hybridisation between polyploid forms. Thus mutation, ploploidy and hybridisation are fundamental to plant improvement. They are the principal causes of variation, and the process

process by which evolution continues, and real progress in plant breeding depends ultimately on a proper knowledge and control of these processes." Mutations in recent years have been speeded up by the use of X-rays and other radiations, xchemicals and extremes of temperature. Polyploids have been produced by chemicals, by deliberate decapitation, wounding, temperature extremes. etc.. (Winkler 40, Jorgenson 30, Kovalevskaja 41).

## RESEARCH PROGRAMME.

It has to be remembered that mango is a fruit with a well developed seed called the stone. The question how far the size of the fruit is correlated with the size of the stone and whether stone development is directly concerned with fruit formation has to be solved. In the majority of varieties the seed appears to be proportional to the size of the fruit. Very few cases are known in which mango fruit is without seeds. But these give a hope that the mango fruit can develop parthenocarpically. There is a large variation in the size of the mango seed, indicating a possibility for reducing the size of the seed. Based on the above data the following programme is intended to be adopted with the aim of producing parthenocarpic mangoes:--

I. INDUCTION OF POLYPLOIDY IN THE MANGOES.--

olchicine or in its absence other polyploidising chemicals to be applied to the growing tips of the plant. For this purpose young grafted plant and also seedlings are to be employed. The polyembryoni mangoes are to be used, especially, as these produce seedlings from the nucellar regions and any change produced in the plant is easily transmitted without change. Parallel with these trials with standard varieties are also to be done.

II. INDUCTION OF GREATER VARIATION THROUGH INTRODUCING WILD BLOOD INTO THE CULTIVATED VARIETIES:-- For this purpose wild mangoes are to be crossed with selected cultivated ones. An exploration of new wild mango varieties available in the forests of the province has to be undertaken. Interspecific hybridisation in the manggoes using M.ZEYLANCICA. M. ODERATA with M.INDICA is to be attempted.

III. INDUCTION OF PARTHENOCARPY BY SPRAYING HORMONES, etc.,--Considerable success has been obtained experimentally in inducing parthenocarpy by spraying plant hormones and growth producing substances at the time of flowering in cucurbits, grapes, tomatoes, apples, etc., recently aerosol has been used as the carrier and atomiser for these chemicals. These experiments have to be tried on the mango and if successful investigations have to be carriedx out to make it economic and easy to he used on a large scale.

IV. INDUCTION OF CHROMOSOME MUTATIONS THROUGH PROMOTING THE DEVELOPMENT OF CALLUS TISSUE.--

Callus tissue is always developed at the union of the stock and scion but the horticulturist rarely allows the bud arising from this callus tissue to develop. They are scrupulously removed. These buds from the callus arise from prolifeating tissue and ~~in~~ many

p.t.o.

in many of these cells there is polyploid formations and cytomixis. It has been observed that buds from such tissue give chimeras, chromosomal chimeras and also polyploid plants. It is of greater interest to study especially the plants obtained from callus regions in cases where the stock and scion belong to different species and generax. New types of plants could be produced by xhombining different kinds of stock and scion.

INDUCTION OF MUTATION THROUGH IRRADIATION.--

X-rays have been proved to increase the mutation rate generally. In the annuals many of these mutations have been found to be of lethal kind. But a number of internal changes in the genetic and chromosome make up of the plants are also found. These traits in the case of annuals become difficult to fix as the propagation is by seeding. This serious defect is overcome in the case of the plants which are vegetatively propagated. Such disturbances as are produced by X-rays may give plants with parthenocarpy with greater probability than by other means. The seedling plants, and also seeds in the first instance and later the grafted plants will have to be exposed to X-rays. If portable X-ray sets are available the stem tips of larger bearing plants may also be exposed.

VI. THE CYTOLOGICAL INVESTIGATIC mitosis and meiosis of the mango as also the embryology of mango has to be studied. The cytological studies on both wild and cultivated types will have to be done. The materials for meiosis will have to be collected during the flowering period. For mitosis trials at inducing cuttings to root should be investigated (certain amount of success has been obtained by the Fruit Specialist and at Kodur). These roots will then be used for the study.

VII. The mango develops only one carpel and gives rise to one seed. It has been clear from the literature reviewed above that greater success is possible in fruits which are scycarpous and that the development of a single seed either viable or not is enough to set the whole ovary to develop further into a fruit. Simultaneously with the mango, trials with fruits like guajava, custard apples and pomegranate also will be done, as these will help in the standardizing of the methods to be used on mango.

PLACE OF WORK.

This work will naturally entail two portions, firstly laboratory investigations and secondly field experiments. The materials available at Kodur Fruit Research Station and the small number of varieties at the Coimbatore College Orchard may be utilized for the study. The laboratory investigations are best carried out at Coimbatore, since there are better laboratory and library facilities. The field experiments may all be carried out at Kodur.

A work of such comprehensiveness and complexity as that sketched above requires adequate staff. The investigations will be carried out by the Cytogeneticist at

at Coimbatore. The Cytogeneticist with his one assistant has the duty of teaching genetics and plant breeding to the III year B.Sc.(Ag.), class. There is therefore need for a special staff to assit him in this work. To help him in the field work at Kodur and in the laboratory work at Coimbatore, two assistants would be exclusively needed. The work of the assistant at Kodur would be to help in such duties as (1) exploration and collection of wild species and varieties of mango, (2) carrying out crosses under controlled conditions at the Fruit Research Station and elsewhere, (3) study inheritance of characters, and (4) maintenance of the seedling or mutant progenies, etc. The other assistant at Coimbatore is necessary to do the laboratory investigations.

FINANCIAL STATEMENT--RECURRING EXPENDITURE.

| Particulars. | I year. (2) Rs. | II ar. (3) Rs. | II yea (4) Rs. | IV year. (5) Rs. | V ear. (6) Rs. |
|---|---|---|---|---|---|
| I Pay Two Assistants at Rs.100--5--140--10--220. | 2,400 | 2,520 | 2,640 | 2,760 | 2,880 |
| II.Cost of living allowance-- For two assistants at 17½ per cent of basic pay. | 576 | 624 | 648 | 672 | 696 |
| III. Travelling allowance-- At Rs.200 a year. | 200 | 200 | 200 | 200 | 200 |
| IV. Apparatus and Chemicals-- At Rs.1,500. | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 |
| V. Other contingencies.. | 250 | 250 | 250 | 250 | 250 |
| Total recurring | 4,926 | 5,094 | 5,238 | 5,382 | 5,526 |

| | VI year. (7) Rs. | VII year (8) Rs. | VIII year. (9) Rs. | IX year. (10) Rs. | X year. (11) Rs. | Total (12) Rs. |
|---|---|---|---|---|---|---|
| I.Pay of staff-- Two Assistants at Rs.100--5--140--10--220. | 3,000 | 3,120 | 3,240 | 3,360 | 3,600 | 29,520 |
| II.Cost of living allowance-- For two assistants at Rs.17½ percent of basic pay. | 720 | 744 | 768 | 792 | 816 | 7,056 |

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| (1) | (7) | (8) | (9) | (10) | (11) | (12) |
|---|---|---|---|---|---|---|
| III. Travelling Allowance---- At Rs.200 a year. | 200 | 200 | 200 | 200 | 200 | 2,000 |
| IV. Apparatus and Chemicals-- At Rs.1,500. | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 | 15,000 |
| V. Other contingencies | 250 | 250 | 250 | 250 | 250 | 2,500 |
| Total recurring | 5,670 | 5,814 | 5,958 | 6,102 | 6,366 | 56,076 |

"Non-Recurring"---Nil.

## FINANCE.

The cost of the staff for a period of ten years and other contingent expenditures have been detailed above. The total cost for ten years will be about Rs.56,076.

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Madras: Printed by the Superintendent, Government Press-1948.

Copy of letter from the Secretary, Indian Council of Agricultural Research, 'P' Block, Raisina Road, New Delhi, No.F.59(22)/48-ADN, dated the 19th February 1949 to the Secretary to the Government of Madras, Development Department Fort St. George, Madras.

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Sub: Scheme for cytogenetic studies on mangoes.

Sir,

With reference to your letter No.3362 AII/49-1,dated the 19th January 1949, I am directed to say that the above mentioned scheme was considered by the appropriate Committees and the Advisory Board of the Council at their meetings held in October 1948 and January 1949 respectively. The Scheme has not been approved by the Council.

Faithfully,

Sd. x x
for Secretary.

Development Department.

Endt.No. 3362-A.4/49-1,dated 8-3-1949.

Communicated to the Director of Agriculture with reference to his letter No. D.2.1015/47,dated 12-12-47.

Sd. x x.
7-3-49.

Copy of letter No. F.59(22)/48-Adm. dated the 22nd April 1949 from the Secretary, Indian Council of Agricultural Research, 'P' Block, Raisina Road, New Delhi to the Secretary to the Government of Madras, Development Department, Fort St.George, Madras.

Subject: Scheme for Cytogenetic studies on mangoes.

In continuation of this office letter No. F.59(22)/48-Adm., dated the 19th February 1949, I am directed to forward herewith an extract from the proceedings of the Advisory Board meeting held in January'49, relating to the scheme mentioned above and to request that a revised scheme in the light of the Board's remarks may kindly be drawn and submitted for the consideration by the Council.

Yours faithfully,
Sd. x x
for Secretary.

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Development Department.

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Endt.No.43089 A.II/49-1,dated 29-4-49.

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Referred to the Director of Agriculture for remarks with reference to his letter No.D.2.1015/47,dated 12-12-47.

To the Director of Agriculture,with enclosure.)

Sd. x x29-4-49.

Extracts from the Advisory Board Proceedings of the meeting held in January 1949.

Cytogenetic studies on Mangoes - New Scheme - Madras.

The Fruit and Vegetable Committee recommended that this work could not be entrusted to Prof.Agharkar because it involved a great deal of field study and required a wide range if breeding material which already existed at Kodur. It also recommended that the scheme be sanctioned for five years only for the present.

TheCommittee also recommended that one Cytogeneticist and two Assistants should be stationed at Kodur. The budget should be revised accordingly.

At the Botany Committee, Dr. Pal stated that the scheme submitted seemed to emphasise on the cytogenetical aspect of the work which may or may not yield useful results. Further, he said, that since a number of such schemes were coming up for consideration, he thought that it would be necessary to have coordinated programme of work so that the investigations may be undertaken on suitable lines. It was pointed out that the cytogenetical schemes had not been fully coordinated with breeding work on the particular fruit crops. It was important to do so if useful results were to be obtained. It was, therefore, considered necessary that work on a comprehensive basis should be undertaken which included not only the cytogenetical aspects of fruit crops. For instance in a fruit like mango, which had been cultivated for so long, no province had undertaken any work to study the extension of natural variation and the behaviour of progeny from individual plants.

The Committee recommended that provinces concerned may be asked to submit schemes which took cognisance of the different aspects involved in the work and these should be coordinated by the Indian Council of Agricultural Research so that breeding work and cytogenetical investigations were suitably linked.

At the Advisory Board, the Chairman pointed out that his remarks on the previous subject regarding regionalisation applied here also. A revised scheme might be called for as desired by the Botary Committee. This subject also would have to be examined by the Regional Committee concerned in due course. The Advisory Board accepted the recommendation of the Botany Committee and endorsed the Chairman's remarks.

Copy of letter No. Y.1.419/49, dated 19-8-1949 from the Director of Agriculture, Madras to the Secretary to Government, Food Department, Madras.

Sub: Scheme for Cytogenetic studies on Mangoes

Ref: Government Endorsement No. 43089-AII/49-1 dated 29-4-49.

I submit hereunder my remarks on the suggestions and criticism made by the Advisory Board.

2. The suggestions and criticisms and that have been made against the scheme are based on inadequate appreciation of the real objectives of the scheme and of the peculiarities of the Mango as also of the work done so far in the line in this Province. The reasons to arrive at this conclusion are summarised below in order to show clearly how the criticisms have been off the mark and why the original scheme merits reconsideration, with complete awareness of all the technical issues involved.

The Committee's criticisms are (1) that the study of extent of material variations in Mango has never been studied in any Province. (2) the behaviour of the progenies of the individudal plants has never been determined, (3) that the programme of work emphasises Cytogenetical aspect only which may or may not yield useful results and (4) that a coordinated programme of work to include cytogenetic and breeding work on Mango should be undertaken..

The first of these criticisms obviously overlooks the fact that the Indian Mangoes are either Polyembryor or Monoembryonic Experience as well as actual observation at the Fruit Research Station, Kodur prove that the former breed true to type and therefore there is not question of extent of variation in this type, on the other hand, the monoembryonic fruit, is cross pollinated and highly heterzygous, a fact well known to every student of horticulture and has been amply proved by research work as well. Most of our present day varieties have arisen as chance seedlings and have been exploited by mango growers who are themselves fully aware of the patent fact that the monoembryonic mango never reproduces true to the seed-parent. It is therefore, amazing to be told that this well known feature of mango reproduction is a matter that has never been worked or that it is a subject that should be given priority in Mango investigations, Nevertheless it may be of information to the Committee to mention here that there are scores of trees at the Fruit Research Station, Kodur which have been raised from seeds from known parents of both polyembryonic and monoembryonic mangoes. These confirm the facts which are already known and which have been outlined, above.

The second objection regarding the behaviour of progenys of individual plants is on a par with the preceding criticism, As already stated the intelligent mango growers all over the country as well as the research findings are available in an ample measure to know how the seed progenies of the polyembryonic and monoembryonic mangoes behave so that there is no point in taking up further work

The third of the criticisms is also based on the wrong presumption. It has to be remembered that the objective of the scheme was to evolve seedless mangoes and methods of achieving these are only those that have been accepted by scientists including breeders of food crops all over the world. Inducing seedlessness through the promotion of bud sports and hormone treatments, which figure prominently in the programme can by no stretch of argument be classed Cytogenetical work. They certainly involve some cytological work but such incidental and prerequisite work cannot justify the criticism as levelled on the scheme.

The last of the criticism is a plea of coordination and for linking the Cytogenetical work with the Breeding work. This is exactly what has been aimed at in the scheme and it is a matter for suprise that this has been overlooked. The only place where breeding works on mangoes is being done on a systematic scale is at present at Kodur, where nearly 10,000 crosses with a multitude of parental combination has been effected and some very promising hybrids already been perpetuated and clonal progenies of which have been introduced in far off lands. Because of this and the fact that a very comprehensive range of breeding material is available at that station that the scheme was decided to be worked at that place. It is clearly impossible to breed a seedless mango of any of the varieties of commercial importance of Madras in a far away province where the conditions and varieties are different and where suitable breeding material can never be available. Any suggestion for coordination will be tantamount to the plea to have a coordinated scheme for the subject for the entire countries of the world.

Hence, none of the criticisms made of the scheme justify the need for a revision of the technical portion of the scheme.

South India is a distinct Mango region with envirenments and variety collections divorced from the rest of the country. There is every justification for finding out how mutations can be evolved with south Indian varieties subjecting them to various chemical or hormone treatments under the growing conditions of this region. Such investigations cannot be carried out elsewhere for the South Indian fruits and there can therefore, be no coordination with the work that may be done elsewhere on the scientific or technical aspect of the programme. There may be room for considerable help from elsewhere and this is provided through the I.C.A.R. Technical Committees. The Fruit and Vegetable Committee has already pronounced its views commending the scheme and the Botany Committee has not detected a single flaw on the technical programme. It has only made some general suggestions which as already explained above are not pertinent and in any case inapplicable. It may be necessary to add that the general trend of the criticism indicates that the Botany Committee has been confusing this scheme on a perennial crop with that of annuals. There is no possible connection between the two and therefore, the coordinated attack on these two distinctly different groups of plants can have no place whatsoever in our objective to breed Seedless fruits from a perennial. It is felt that the limited objective set before the scheme cannot be materially influenced by schemes on crops which have no relationship with the Mango

3. As recommended by the Fruit and Vegetable Committee the budget estimate has been revised limiting the scheme for a period of five years in the first instance which is enclosed herewith.

4. The Cytogeneticist stationed at Coimbatore will supervise the work of the assistants and hence no provision is made in the budget for another Cytogeniticist.

5. I request that my views with the revised budget estimate may be communicated to the Indian Council of Agricultural Research, for reconsideration of the scheme already submitted.

Sd. C.R.Srinivasa Iyengar,
for Director of Agricul

Copy to the Cytogeniticist, Lawley Road P.O.
through the Principal, Agricultural College
Lawley Road P.O.
Copy to the Fruit Specialist. Madras.

/True copy/forwarded/By order

Sd. x x
Gazetted Assistant.

Food & Agricultural Department

Letter No. 43089 K/49-2,dated 10-9-49.

To
The Secretary to the Indian Council of
Agricultural Re
New Delhi.

Sir,

Sub: Agriculture - Indian Council of Agricultural Research - Scheme for Cytogenetic studies on Mangoes.
Ref: Your letter No.F.59-(22)/48-Adm.dt.22-4-49.

I am directed to forward herewith a copy of the letter No.Y-1.419/49,dated 19-8-49 received from the Director of Agriculture, Madras containing his remarks on the suggestions and criticisms made by the Advisory Board on the scheme mentioned above. The Government of Madras agree with the views expressed by the Director of Agriculture

2. According to the revised estimate of expenditure now furnished by the Director of Agriculture, the scheme is estimated to cost Rs.26,166 for five years. I am to request that the sanction of the Indian Council of Agricultural Research to meet 50% of the expenditure involved may kindly be obtained and communicated to this Government.

ours faithfully,

Sd. x x
Secy. to Government.

Copy to the Director of Agriculture.

Copy of letter No.F.59(22)/48-Adn., dated the 17th November 1949 from the Secretary to the Indian Council of Agricultural Research, 'P' Block, Raisina Road, New Delhi, to the Secretary to the Government of Madras, Food and Agriculture Department, Madras.

Sub: Scheme for Cytogenetics studies on mangoes.

With reference to your letter No.43089-K/49-2 dated the 10th September, 1949, I am directed to say that letter No.Y.1-419/49, dated the 19th August, 1949, from the Director of Agriculture, Madras, containing his remarks on the suggestions and criticisms made by the Advisory Board on the scheme mentioned above, was forwarded to Dr. B.P. Pal, (Head of the Division of Botany, Indian Agricultural Research Institute,) Chairman of the Botany Committee for comments. His remarks are enclsed.

It is requested that a revised scheme may kindly be drawn up in the light of Dr. Pal's remakrs and submitted for the consideration of the Council.

Yours faithfully,

Sd. x x
Secretary.

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REMARKS OF DR. B.P. PAL, HEAD OF THE DIVISION OF BOTANY, INDIAN AGRICULTURAL RESEARCH INSTITUTE.

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The Comments which I made regarding the scheme on the "Cytogenetic studies on mangoes" at the Botany Committee meeting were meant to be on broader aspects of the scheme rather than on details and also on the general principle of coordination of research schemes sponsored by the Indian Council of Agricultural Research. I regret to note that these were not fully appreciated and arguments have been advanced by the Director of Agriculture, Madras, to justify the programme of work. It is stated that the "technical portion of the scheme does not need revision." I offer my remarks as below:-

GENERAL.

1. It is common knowledge that there is good deal of variation amongst mangoes and that a monoembryonic mango seldom breeds true to the seed parent. It is also well known that amateur horticulturists following empirical lines through years of selection, have produced most of the large number of edible varieties. What was emphasized in my comments, was, that the prerequisite of any breeding programme is a systematic assessment of the range of variation within mango varieties, and more so within the progenies of a single plant as we know that mangoes are highly heterozygous and cross-pollinated. This is essential in any scientific breeding programme. The Director of Agriculture Madras has remarked that enough knowledge on this aspect of mango breeding is already available but no reference of any work of such a nature in mangoes is given in the scheme although enough mention has been made about work done abroad on fruits of temperate climates. The number of polyembryonic types compared to mono-embryonic types, is negligible.

2. My opinion, that there seemed to be more emphasis on cytogenetical aspects, is not considered to be correct. It is argued that the principal objective of the scheme is to evolve seedless mangoes and this cannot "BY NO STRETCH OF ARGUMENT BE CLASSED AS CYTOGENETICAL WORK". However the title of the scheme "Cytogenetic studies in mangoes". Further comment on this point is not necessary.

3. I maintain that, to achieve fruitful results in shortest time, cytogenetical and breeding schemes in any particular crop sponsored by the Indian Council of Agricultural Research should be coordinated. Here against it has been argued that this is precisely the purpose of the scheme and Kodur Station alone in India is suitable for undertaking breeding work in mangoes. In the body of the scheme, however, no proper breeding programme has been given except mentioning that attempt will be made to induce greater variation in cultivated mangoes, by introducing in breeding programme wild mangoes (most of which has to be obtained by exploration), MANGIFERA ZEYLANICA (species from Ceylon), and M. ODORATA (a Malayasian species).

## ECHNICAL PROGRAMME.

### 1. INDUCTION OF POLYPLOIDY IN THE MANGOES.

In view of the fact that mangoes can be propagated vegetatively, induction of polyploidy even in an allopolyploid crop like mango, with 2n = 40 chromosomes is worth while trying. This item of the programme is recommended.

### 2. INDUCTION OF GREATER VARIATION THROUGH INTRODUCING WILD BLOOD INTO THE CULTIVATED VARIETIES;--

No mention is made of the list of wild varieties available at Kodur and their important economic characters which are inteded to be introdduced in the cultivated mango by hybridization. In view of insufficient knowledge available regarding the range of variation in mangoes, as pointed out in page11, para 2, the breeding programme has bo be revised. With the limited resources as provided in the scheme the exploration work of wild mangoes is not a practical proposition and should be the objective of a separate scheme

### 3. INDUCTION OF PARTHENOCARPY BY SPRAYING HORMONES et

Experimental studies on young plants to find out whether hormones or similar re-agents can induce parthenocarpy or seedlessness are worthwhile. Its application on a big tree with thousands and thousands of minute polygamous flowers is however another problem. Specially, when we know that out of 2000 to 6000 flowers per inflorescence, only 1.25 to 35.6 percent are bisexual, i.e. potentially capable of producing fruits, whereas the rest are functionally male flowers. Again out of this small percentage of fruit setting flowers, only 13.4 to 28.4 per cent, actually matures and the rest drop before reaching maturity. It appears therefore that there is also good scope to try out experiments on the effect of spraying suitable hormones to prevent premature dropping of fruits in addition to inducing parthenocarpy.

INDUCTION OF CHROMOSOME MUTATIONS THROUGH PROMOTING THE DEVELOPMENT OF CALLUS TISSUE.

This is interesting and work may be taken up at Kodur.

5. INDUCTION OF MUTATION THROUGH IRRADIATION:

The probability of isolating an useful mutation by X-irradiation depends primarily on growing a very big population of irradiated material because most of the mutations are lethals. The mutations, if there be any, could only be detected by selfing large numbers of flowers of the treated population and growing a large progeny. It appears that all the above implications, including the practical aspect of exposing the stones or the seedlings as suggested t prolonged irradiation, have either been ignored or not known to the author of the scheme. Even if an X-ray apparatus is available about which no mention is made, I suggest that this item of work should not be taken up now.

6. THE CYTOLOGICAL INVESTIGATIONS;

Work on similar nature has already been done in Calcutta (vide Indian Council of Agricultural Research report on Cytogenetic studies in Mangoes and Bananas) by S.P. Agharkar on a fairly large number of mango varieties, including few south Indian varieties and the wild species M.SYLVATICA and M. CALONEURA. Work on similar lines is now also being continued at Poona by Prof. S.P. Agarkar. To avoid duplication this item of the programme may be dropped.

7. It is obviously impossible with the limited resources and personnel, shown in the budget provided, to carry out investigations on all the above lines in mangoes, not to speak of investigations on similar line in other fruit crops as well, like Guava, custard apples, Pomegranates, etc. as programmed. This item of the programme should also be dropped.

The whole research scheme gives one the impression of an effort to do scattered research work in various problems and as such cannot be encouraged. Besides, the Committee should consider seriously whether there are suitable men available who can conduct research work simultaneously in so many different lines, I think the scheme requires thorough revision and should be restricted to item Nos. 1, 3 and 4.

Development Department

Letter No. 43089 K/49-11,dated 25-5-50.

To

The Secretary to the Indian Council of
Agricultural Research,
New Delhi.

Sub: Agriculture - Indian Council of Agricultural Research - Scheme for Cytogenetic studies on mangoes.

Ref: Your Letter No.F.59(22)/48-Adn.,dated 17-11-49.

I am directed to state that the views expressed by Dr. B.P. Pal on the scheme mentioned above in his note communicated with the Indian Council of Agricultural Research's letter cited are not agreed to by the Director of Agriculture, Madras. As the scheme is not immediately essential, I am to state that it may be considered to have been withdrawn.

Yours faithfully,

Sd. x x
Secy.to Government.

Copy to the Director of Agriculture.

(Issued as Lr. No.43089 K/49-11,dated 25-8-50).

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/True copy/

R. Thiagarajan 3-2-54
Office Assistant,
Madras Record Office.

PSR. 18-9-53.

JCH 6.1.54 CVDP 6-1-54.